Ground Penetrating Radar (GPR) investigations at the ancient site Kampil, Farukkhabad (Dist)

Report

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1. Introduction

The village of Kampil at latitude 27˚ 36′ N and longitude, 79˚ 17′ E, is situated in the district of Farrukhabad, tahsil of Kaimganj (Uttar Pradesh), about 45 km north west of Fatehgarh. It is a village of the Ganges plain, in the Doab between the Ganges and Yamuna rivers. Kampil was first identified with Kampilya, the capital of Panchala, by A. Cunningham, who visited the site in March 1878. Kampilya has been mentioned in the Mahabharat as well as other ancient texts as the southern capital of the Panchala- one of the 16 Mahajanapadas. The mound that characterizes the site was told him as one corresponding to the site of King Dhrupad. Alexander Cunningham suggested the possibility that ancient buildings of the time of Mahabharata might have existed at Kampil but have been swept away long ago in 745-1345 AD during the times of invasion of the Gangetic doab by Muhammadans who established their settlement ad gradually over the period a town arose under the name of Sargdwari "(Swarga-dwari)". There are no traces of old buildings, but only a succession of undulating grounds, rising in some places to high mounds with broken bricks thinly scattered here and there. Also, there are several holy ghats in the ponds, in which pilgrims bathe, but there is no runningstream. The site of Raja Drupada's palace is pointed out as one of the most easterly and isolated mounds which is about 400 feet long and from 200 to 250 feet broad, rising to 20 and 25 feet in height on the banks of the burhi Ganga.

Only 80 years later Kampil once again become the object of archaeologist's consideration. It emerged both in the list of sites with painted grey ware PGW and NBPW made by B.Lal in 1954-55. The official survey of the site goes back to 1961, carried out by V.N.Mishra of the Deccan College, Pune. He confirmed the identity of the present village with Kampilya. In the year 1976 K.K.Sinha from B.H.U, excavated at Kampil with the aim of defining the area where PGW was restricted. The excavations showed that the deposit of PGW 22.40m thick lay on the natural soil together with fine grey ware, Black Slipped Ware (BSW) and Black and Red Ware (BRW). The overlying layers belonged to the late medieval period. Though many archaeological investigations

have been carried out at the site yet no concrete picture emerged about the ancient habitation at the site.

The site appears to have a close relation with brahmanical tradition, many vestiges of temples have been occasionally found some of which can be seen at the modern Jain Temple. Recently, those ruins are being investigated by archaeological excavation procedures. As a part of these investigations, an attempt has been made to map subsurface archaeological remnants at Kampil using non-destructive geophysical tool known as Ground Penetrating Radar (GPR).

2. Objective & Scope of Work

To undertake Ground Penetrating Radar (GPR) survey at Kampil, a three member team consisting of Mr Santi Swarup Sahoo & Ms. S. Sravanthi accompanied by Mr. Neeraj Kumar visited the archaeological site on 25th March 2012. The main objective of the survey is to identify and map the sites of buried remnants of Panchala Empire which will be later on considered for excavation to reveal the buried structure.

3. Ground Penetrating Radar

GPR is a non-destructive geophysical technique which provides continuous high-resolution image of the shallow subsurface up to 50 m (Davis and Annan, 1989; Neal, 2004). The technique uses electromagnetic waves, typically in the range of 1 to 1000 MHz frequency. The radar image comprises the reflected electromagnetic waves (radio waves) that passes through the ground and are returned to the surface. A transmitter sends electromagnetic signal into the subsurface, and the radar waves propagate at velocities that are dependent upon the dielectric constant of the subsurface medium. Change in the dielectric constant that is due to change in the subsurface materials causes the radar waves to reflect (Davis and Annan, 1989; Anderson et al., 2003). This technique has been employed in fields like engineering, geology, environmental studies, and more recently, archaeology because of its non-invasion investigation. GPR surveys in archaeological studies have provided successful results in a wide variety of applications such as search for graves, burial sites, human remains and detection of

buried foundations, walls & floors (Vaughan, 1986; Imai et al., 1987; Bevan, 1991; Mellett, 1992; Unterberger, 1992; Sternberg and McGill, 1995). GPR setup mainly consists of bistatic antenna (both transmitter & receiver), control unit for the display of data, odometer for distance calibration and fiber optic cable which connects both antenna and control unitfor data transmission (Figure 1).



Figure 1: Field photograph at Kampil showing data collection using Ground Penetrating Radar setup consisting of 200 MHz antenna, odometer, fiber optic cable and control unit.

4. Data Acquisition, Processing and Interpretation

Data was collected in common-offset continuous mode using portable SIR 3000 by Geophysical Survey System Inc. For the present survey, 200 MHz antennawas used to map the buried remnants at the archaeological sites of Kampil. Few places at present day Kampil are of high mounds exhibiting archaeological significance and few sites were occupied by local dwelling. Two sites were considered for GPR survey at Kampil in which16 two-dimensional profiles and 2 three dimensional profiles were collected (Figure 2). Initially 2D profiles were collected for finding out the location of buried

remnants; later on detailed 3D profiles were collected to understand the extent of buried feature. For the acquisition of 2D data profiles,TerraSirch was used as it forms the best suitable mode for initial observations. Acquired data has been processed using RADAN 6.5 for better interpretation. Both acquisition and processing parameters are given in Table-1. All the 2D profiles were collected to identify the structure present beneath the ground and the potential sites were considered for 3D survey. So, detailed 3D profiles were explained in the following text.



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Figure 2: Google Earth image showing the location of Kampil and two sites undertaken for GPR survey which are indicated as K1 & K2 respectively

Table :1 Data Acquisition and Processing Parameters

Data Acquisition Parameters									
Mode	Profile	Antenna	T-Rate	Sample	Range/Depth	Dielectric constant	IIR-Low pass	IIR-High Pass	Stacking
TerraSirch	2D	200 MHz	100	512	120	6	600	50	10
	3D	200 MHz	100	512	100	6	600	50	5

Data Processing Parameters				
	Time – zero correction	FIR – Low pass	FIR – High pass	Horizontal scans
2D	7.89	655	105	5
3D	8.13	655	155	3

4.1 Site-1 (Jain temple site):

Site-1 (27° 36′ 52.6″N; 79°16′33.0″E) was located at the isolated area from the household areas. Few portions are been excavated at this site and a ruined bastion of the medival fort can be seen at the site suggesting the Muhammadan occupation of the site. Also, there is construction of Jain temple going on at the site located behind the survey area indicating the recent introduction of Jainism at the site. A 3D grid (Grid-A) of dimension 10 m x 6 m was collected at the site using 200 MHz antenna (Figure 3).



Figure 3: Field photograph of site-1 showing the location of 3D grid collected and also ruins of the stupa existed in the site. Also the construction of Jain temple is going on at the site located behind the survey site

Three dimensional profile collected, Grid-A, has been illustrated in the form of horizontal slices showing the image of subsurface at each individual slice allowing us to identify the continuity of the structures on to the adjacent slices (Figure 4). Grid-A was illustrated in total six slices (i-vi) whose reflections are continuous to the depth of 5 m approximately. The grid shows two series of reflections whose separation can be seen between slices (iii) & (iv). Slices from (i)-(iii) shows a peculiar pattern of reflections suggesting the patterns to be compacted surfaces that are converging towards each other. Slices from (iv)-(v) shows high contrast reflections extending throughout the

width of the slice suggesting the pattern to be debris.The slices (iii) & (iv) shows a prominent hyperbola at 0-2 m which are continuous to the depth of 4 m which could be suggestive of a structure present beneath the compacted surface. This structure could be a cylindrical object or a wall base or most like a stone paved street. As the ruins of bastion are lying very close to the collected grid area the debris may be related to it.

4.2 Site-2 (Ramleela Maidan)



Figure 4: Field photograph of site-2 showing the location of 3D grid collected at the site. The survey site was used as public gathering place and shows no archaeological significance.

Site-2 (27° 36′ 52.6″N; 79°16′33.0″E) was located within the modern residential area unlike site-1.The site was used by the local people as public gathering place and there is no ruins of archaeological significance on surface or in the nearby area because of local people occupancy. Four 2D profiles were collected at this area in which all the profiles suggested the existence of structure beneath. So, a 3D grid (Grid-B) of dimension 10 m x 8 m was collected at the site using 200 MHz antenna (Figure 5).

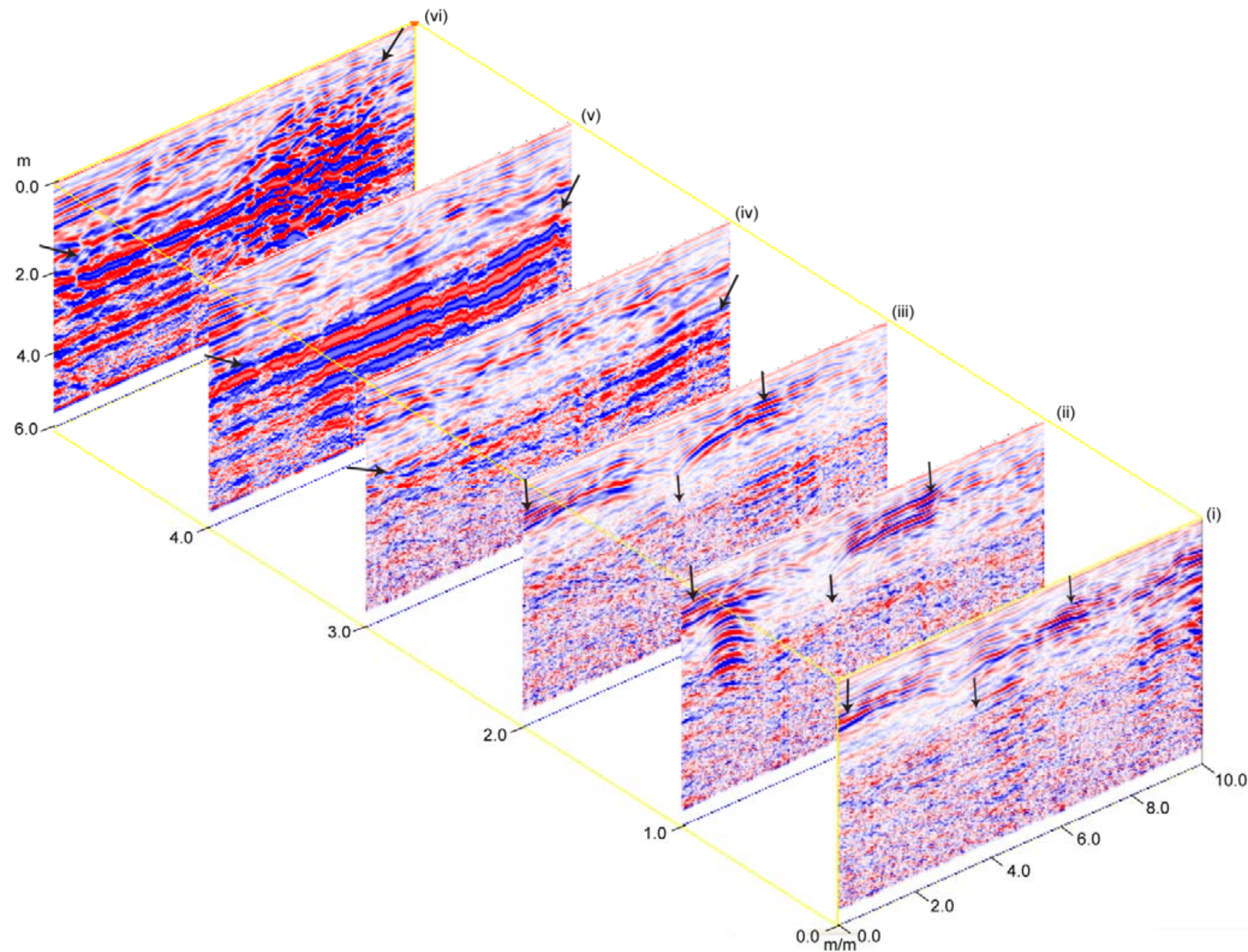


Figure 5: Grid-A showing six slices (i-vi) whose reflections are continuous to the depth of 5 m approximately. Slices from (i)-(iii) shows a peculiar pattern of reflections suggesting the patterns to be compacted surfaces that are converging towards each other. Slices from (iv)-(v) shows high contrast reflections extending throughout the width of the slice suggesting the pattern to be debris. The slices (iii) & (iv) shows a prominent hyperbola at 0-2 m which are continuous to the depth of 4 m which could be suggestive of a structure present beneath the compacted surface. This structure could be a cylindrical object or a wall base or a stone paved street.

Two-dimensional profile collected has shown distinctive structure in both the directions. Two 2D profiles were illustrated to show the feature obtained before the collection of 3D profile (Figure 6). 2D profile collected in NE-SW direction at Ramleela Maidan which illustrates the feature between 6-18 m in total profile of 21 m. Feature indicated in black arrows at 6-8 m is very vague and cannot be noticed properly. But the feature indicated in red arrow at 11-18 m shows the high reflections which may suggest the traces to be of wall structure. 2D profile collected in SW-NE direction adjacent to the profile shown in (a). The feature can be seen in between 2 – 14 m from total length of profile of 20 m. Feature shown in red arrow at 2-9 m replicates the reflections of 11-18 m in the profile shown in (a) there by suggesting the traces to be of wall structure. Feature shown in black arrows at 12 -14 m is so prominent unlike the reflections at 6-8 m in profile shown in (a) suggesting the traces to be of a cylindrical object.

Three-dimensional profile collected, Grid-B, also has been illustrated in the form of horizontal slices showing the image of subsurface at each individual slice allowing us to identify the continuity of the structures on to the adjacent slices (Figure 7). Grid-B was illustrated in total six slices (i-vi) whose reflections are continuous to the depth of 6 m approximately.The 2D profile shown in Figure 6a and 6b represents the slices of (v) & (iv) respectively. The grid shows same pattern of reflections throughout the length of the profile i.e 10 m. The pattern of reflections is marked with arrows showing the continuation of reflections on to the adjacent slices. Two patterns of reflections both onto the left and right are marked on the slices (i)-(iii) which suggests the patterns could be of wall reflections. From slices (iv)-(vi) two patterns of reflections onto both left and right can be observed. The reflections on the left show the similarpattern of reflections in slices (i)-(iii) suggesting the traces of deserted wall structures but the reflections on the right shows different pattern than earlier may suggests the reflections of cylindrical object.

The reflections from both the sites suggest different patterns thereby suggesting presence of varied structures beneath. Site-1 revealed reflections that could be

suggestive of debris of ruined bastion and the second pattern of reflections showing convergence may suggest the walkway provided towards the stupa and the convergence may suggest the presence of linear waterway. There is an observation of reflections suggesting cylindrical object or wall related structure to the left of profile. As the grid was collected adjacent to the bastion strengthens the interpretation of debris and also the convergence located at 1 m distance from the debris also strengthens the interpretation of walkway towards an entry near the bastion. Site-2 revealed reflections of two separate patterns suggesting the reflections could be of an isolated cylindrical object and deserted wall structures. As the alignment of reflection is in same direction and size, it may suggest the feature to be linear and not connected to any other feature.

As the surveyed area is in small pockets and not interconnected, detailed interpretations cannot be made and no connectivity can be established between two sites. It can be said that the both sites can be excavated for interesting findings at the locations.

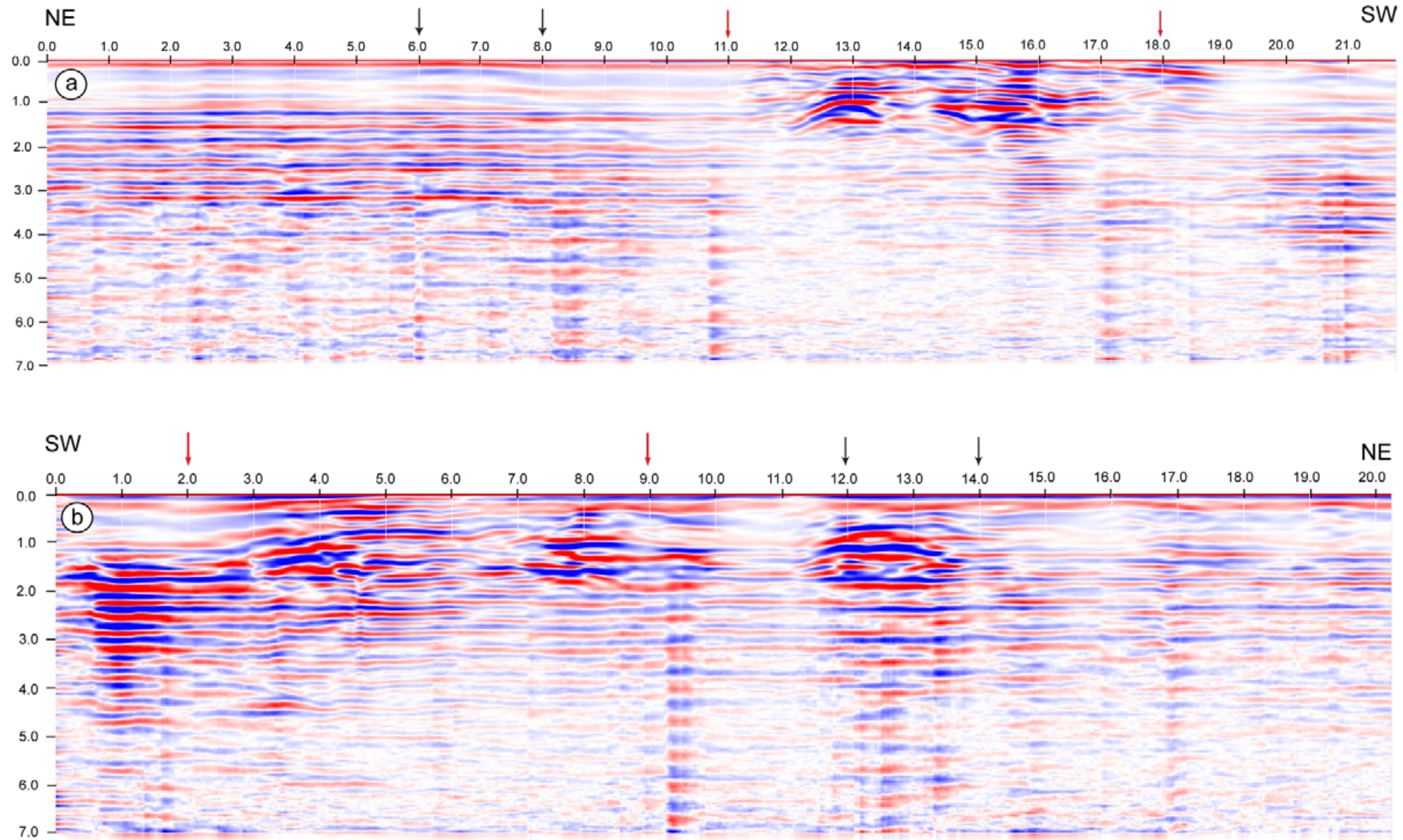


Figure 6: a) 2D profile collected in NE-SW direction at RamleelaMaidan which illustrates the feature between 6-18 m in total profile of 21 m. Feature indicated in black arrows at 6-8 m is very vague and cannot be noticed properly. But the feature indicated in red arrow at 11-18 m shows the high reflections which may suggest the traces to be of wall structure. b) 2D profile collected in SW-NE direction adjacent to the profile shown in (a). The feature can be seen in between 2 – 14 m from total length of profile of 20 m. Feature shown in red arrow at 2-9 m replicates the reflections of 11-18 m in the profile shown in (a) there by suggesting the traces to be of wall structure. Feature shown in black arrows at 12 -14 m is so prominent unlike the reflections at 6-8 m in profile shown in (a) suggesting the traces to be of a cylindrical object.

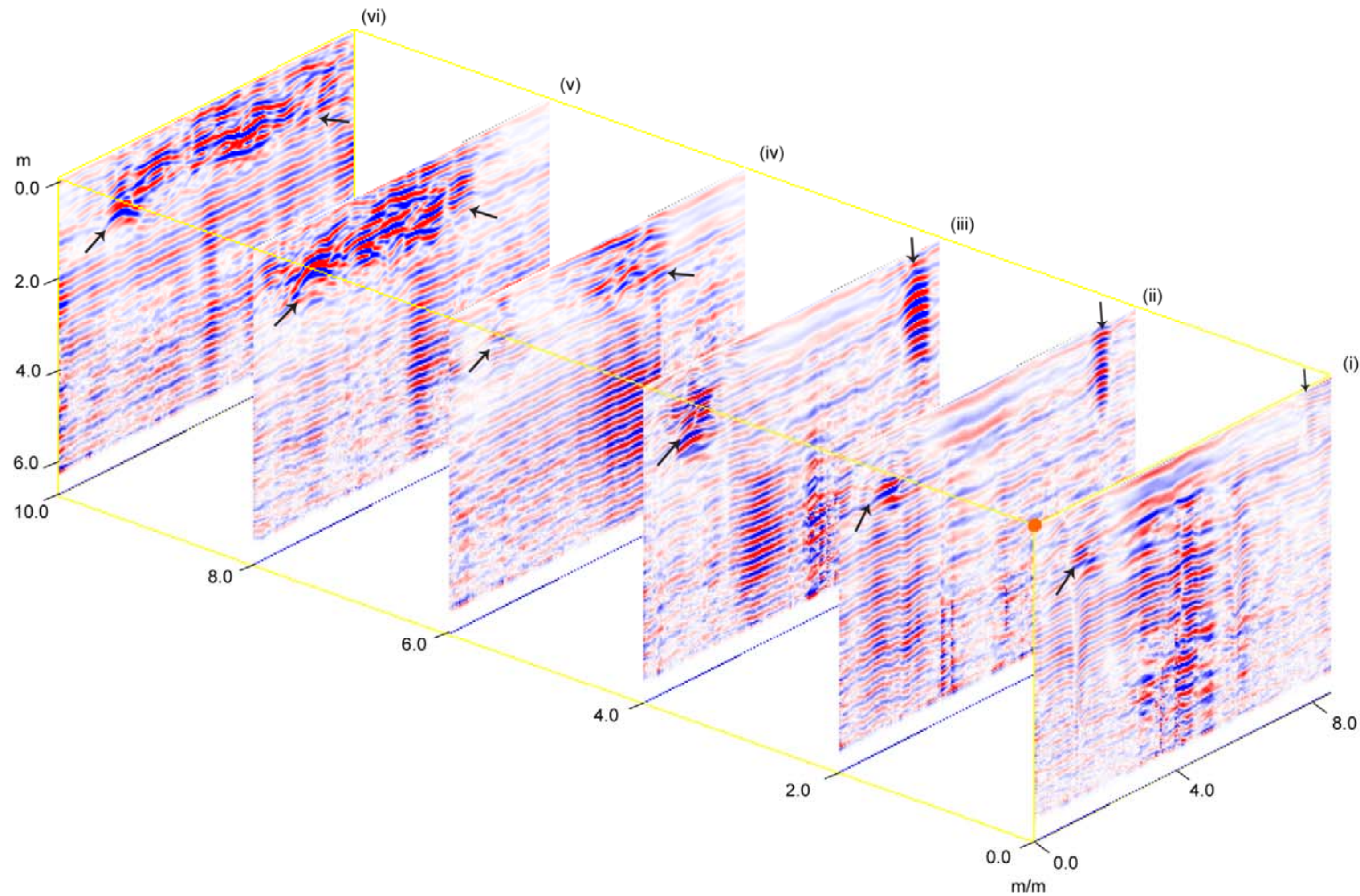


Figure 7: Grid-B was illustrated in total six slices (i-vi) whose reflections are continuous to the depth of 6 m approximately. Two patterns of reflections both onto the left and right are marked on the slices (i)-(iii) which suggests the patterns could be of wall reflections. From slices (iv)-(vi) two patterns of reflections onto both left and right can be observed. The reflections on the left show the similar pattern of reflections in slices (i)-(iii) suggesting the traces of deserted wall structures but the reflections on the right shows different pattern than earlier may suggests the reflections of cylindrical object.

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